

WHAT IS CLAIMED IS:

1. A quick start system for enabling rapid fuel cell power from sub-freezing initial conditions comprising:

a cell stack assembly having a sump containing water;

a heat exchanger;

first feed means for feeding a heat source to the heat exchanger;

a source of antifreeze coolant; and

second feed means for feeding antifreeze coolant to the heat exchanger for heating same and passing the heated antifreeze coolant to the sump for heating the water in the sump.

2. A system according to claim 1 wherein the heat source comprises a catalytic combustor for combusting a mixture of fuel and air to produce a hot gas which passes to the heat exchanger.

3. A system according to claim 2 further comprising a flash vaporizer downstream of the heat exchanger and upstream of the cell stack assembly for receiving the hot gas.

4. A system according to claim 3 including third feed means for feeding water from the sump, in heat exchange relationship with the heated antifreeze coolant, to the flash vaporizer.

5. A system according to claim 1 wherein the second feed means includes valve means for bypassing the heat exchanger wherein the antifreeze coolant is fed to the sump.

6. A system according to claim 4 wherein the second feed means includes valve means for bypassing the heat exchanger wherein

the antifreeze coolant is fed to the sump.

7. A system according to claim 6 wherein the third feed means includes valve means for bypassing the flash vaporizer wherein the water from the sump is fed to the cell stack assembly.

8. A system according to claim 4 including fourth feed means for feeding a fuel to the flash vaporizer.

9. A system according to claim 8 wherein the flash vaporizer communicates with the cell stack assembly.

10. A system according to claim 4 wherein the antifreeze coolant is contained in a closed loop.

11. A system according to claim 2 wherein the fuel is H_2 .

12. A system according to claim 8 wherein the fuel is H_2 .

13. A method for providing a quick start for a fuel cell from sub-freezing initial conditions, comprising the steps of:

providing a cell stack assembly having a sump containing ice;

providing a heat exchanger;

feeding a source of heat to the heat exchanger;

feeding a source of antifreeze coolant to the heat exchanger for heating same;

feeding the heated antifreeze coolant to the sump for melting a portion of the ice to water; and

passing the water from the sump to a flash vaporizer where it is mixed with a fuel and a combustion product from a catalytic combustor and vaporized to provide a hot air and steam feed for the cell stack assembly start up.

14. A method according to claim 13 wherein the fuel is H₂.

15. A method according to claim 13 wherein the combustion product of the catalytic combustor is the source of heat for the heat exchanger.

16. A method according to claim 13 wherein the antifreeze coolant is heated to a temperature of between 100 to 175°C.

17. A method according to claim 13 wherein the hot air/steam feed is heated to a temperature of between 100 to 125°C.

18. A method according to claim 13 wherein the water passing from the sump to the flash vaporizer is heated indirectly by the heated antifreeze coolant passing from the heat exchanger to the sump.

19. A method according to claim 13 further including the step of, after start up, bypassing the heat exchange with the antifreeze coolant and feeding the antifreeze coolant through the sump and to a radiator.

20. A method according to claim 13 wherein the antifreeze coolant is in a closed loop.

21. A method according to claim 19 wherein the antifreeze coolant is in a closed loop.

22. A method according to claim 13 wherein the source of heat is at a temperature of $\leq 300^{\circ}\text{C}$.